Initial Works in the Adaptation of Microorganisms

by L. G. Loginova

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There is rather extensive literature, both Russian and foreign, devoted to the action of various factors on microbes for the purpose of changing their characteristics. However, in many experiments chiefly X rays or powerful chemical agents, which evoked accidental changes in microbes, were used. The most that resulted was only a mechanical selection of colonies when the planting was done in standard culture mediums. Only michurinist biology, based on a dialectic understanding of inheritance and its alteration, blazed a creative path for the establishment or new forms of living organisms, having shown the role and significance of external environmental factors in the process of the organism's development.

In order to obtain new characteristics in the organism it was at first necessary to weaken its heredity, and then....."plastic, non-established ~~plant~~ vegetative forms, obtained ~~in a hit-or-miss~~ some manner, must, from generation to generation be ~~sifted~~ planted out only under such conditions, that need or ~~persistence~~ and tolerance for ~~which~~ them must be developed in the given plants" (Lysenko [2]). The ways of governing changes in the nature of organisms, so brilliantly worked out by Michurin and his ~~continuer~~ successor Lysenko, can also be used to obtain new characteristics in microorganisms. Today a vast amount of material has been amassed confirming the fact that the nature of microbes can be altered by ~~governing their breeding~~ directed adaptation. Thus, as a result of long cultivation of microorganisms under fixed environmental conditions in which they are subjected to gradually increasing doses of some factor, new

characteristics ~~strengthened by heredity~~ hereditarily fixed can be obtained in the microbes.

In a given instance some factor (physical, chemical, biological), to which we adapt the organism, at first creates conditions in the culture unfavorable for development and helps weaken the heredity base of the microbes. According to the degree of adaptation on the part of the organism to a definite concentration of a chosen substance, the quantity of the substance must gradually be increased. In addition, knowing the biology of the given organism, it is necessary to select for its development a culture so composed that it will be specific for the governed change in the definite function of the microbe.

It is interesting to note that even in the past century the attention of researchers was drawn to the study of this problem.

Our outstanding countryman, Mechnikov [3], who wrote many works on directed alteration of organisms, could not solve it. In 1888 he published a resume of works on adaptation of single-celled organisms in which he included both material from his own personal investigations and from those of his students.

The first systematic work on the adaptation of microbes was done by our Russian scholar Kosyakov [1] (1887).

Studying the antiseptic action of borax, boric acid, and corrosive sublimate on various bacilli (the bacilli of malignant anthrax, Bacillus subtilis, Thyrothrix scaber and Thyrothrix tenuis), the author came to the conclusion that microbes, in the process of long cultivation in the presence of an antiseptic, can gradually adapt themselves to it. Kosyakov performed experiments on the

adaptation of microbes in cultures containing gradually increasing quantities of some substance. Thus, the ordinary bacillus of malignant anthrax, which did not develop in a culture containing 0.004 percent borax, after gradually becoming accustomed to the given antiseptic began to develop freely in a culture containing the above-mentioned dose. Thyrothrix tenuis usually ceases its development at a borax concentration of 0.016 percent in the culture, while for the adapted culture, the concentration which retards development is 0.021 percent. Boric acid displays a more powerful antiseptic action than borax. Corrosive sublimate is even more poisonous for the given microbes. Below are figures which show at a glance the relationship of various groups to corrosive sublimate.

Name of Culture	Concentration of Corrosive Sublimate Retarding Growth of Microbes	
	Control	Adapted Culture
Bacillus of malignant anthrax	1 : 20 000	1 : 14 000
Thyrothrix Scaber	1 : 16 000	1 : 12 000
Bacillus subtilis	1 : 14 000	1 : 10 000
Thyrothrix tenuis	1 : 10 000	1 : 6 000

On the basis of the experiment conducted, the author came to the following basic conclusions:

1. Through prolonged cultivation in a culture containing gradually increasing doses of antiseptic, microbes can be adapted to develop under doses which under ordinary conditions would be lethal for them.

2. The rapidity of adaptation of different groups of microbes to the antiseptic is different; the same is true of their adaptation

to different poisons.

In this way Kosyakov, the first investigator to work on the problem of the adaptation of microbes, stated in his work many basically important theses, which serve even today as guiding ideas in the study of the problem.

About the same time (1891) another of our countrymen, Savchenko, (Mechnikov's pupil [4]), also discovered that under fixed conditions of cultivation the bacilli of malignant anthrax can be made to adapt to rat serum, which, under ordinary conditions, was lethal for them.

In this way, it was found that the given culture acquired an immunity to the poisonous substance of rat serum. Danysz (1900) [5] confirmed this fact and showed that the bacilli of malignant anthrax, when adapted to this poison, acquired the ability to secrete a large amount of mucous, forming a mucous membrane around themselves. This membrane adsorbs the poison in the rat serum and through this renders it innocuous.

Along with this Danysz showed that the same culture, adapted to arsenic, possesses a similar characteristic. The author was able to observe that after many consecutive transplantings of the given microbe to cultures with gradually increasing amounts of arsenous acid, the cells begin to secrete mucous, which serves the microbe as a "protective sheath" against the poison.

Thus, our Russian investigators were the first to make profound analysis of the process of adaptation taking place in microbes in connection with changes in the environment, and discovered many laws which govern this process.

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Institute of Microbiology
Academy of Sciences USSR
Moscow

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